Mass Flow Controller Instruction Manual

MC-3000L-TC Series

Safety Precautions

⚠ **WARNING**   **Incorrect handling may cause death or injury**

(1) Before connecting the fittings, check that no damage or defects are found on the fittings. Make connections properly and make sure that a leak test is conducted before actual operation to prevent fluid from leaking into the atmosphere (Hereafter, the measured fluid is called "gas" or "fluid").
(2) **DO NOT** apply any fluids corrosive to materials exposed to gas. Corrosion may cause fluid to leak into the atmosphere. Check the gas type to be used in advance.
(3) This device is not designed as an explosion proof structure. **DO NOT** use this device in a place where explosion-proof structures are required. Doing so may cause fire or explosion.

⚠ **CAUTION**   **Incorrect handling may lead to medium or slight injury or may cause damage to, or loss of, facilities or equipment**

(1) Observe the precautions listed in the WARNING (above).
(2) Strictly observe the electrical specifications. Not doing so may cause fire, damage to sensors or malfunction.
(3) This device is not designed to be waterproof. **DO NOT** locate this device outdoors or in a place where it may be splashed with water. Doing so may cause fire, trouble, or malfunction of the device.
(4) **DO NOT** modify this device. It may cause fire or other problems.
(5) While a power supply is applied to the device, +15VDC and -15VDC must be applied simultaneously. If only +15VDC or -15VDC is applied, electronic circuits will become unstable and it may cause a malfunction.
(6) This device is not designed to handle hot swap. Please avoid attaching and removing the power supply connector and interface connector with the power switched on. Attachment and/or removal with the power on may result in failure of the device.
(7) This device is a precious device, please handle it carefully. Dropping down or handling it carelessly will cause damage. Please use assist instrument while moving or setting the device.
(8) Regular maintenance is recommended for steady use of this device (Recommended proofreading frequency is once a year).

1. Introduction

This manual explains basic operation of the MC-3000L-TC series (Hereafter, it is called "MFC"). Please read through this manual and other separate volumes (Digital Interface Manual, Special Function Manual, Command Chart) carefully to familiarize yourself with the features of this device.

2. Summary

The MFC is high performance mass flow controller for gas using thermal flow sensor and high response solenoid actuator valve.

3. Features

The MFC is the following features.
(1) LINTEC's proprietary ambient temperature compensation type flow sensor is carried.
· Low sensor temperature, long-time steady monitor, and few problems such as degradation of gas to be monitored.
· The effect of ambient temperature is less because the sensor temperature is kept at the ambient temperature.
· Steady temperature distribution of sensor and high-speed response.
(2) Digital computing system with microprocessor and high-resolution A/D, D/A converter is carried.
· High functionality.
· By setting of device number (address), multiple devices can be controlled through a single interface.
· Many additional are provided as standard, e.g., totalizer function, zero adjust, ramping function.
(3) Universal digital Interface (RS-485).
(4) Small dead space structure using a diaphragm valve.
(5) Superior corrosion resistant sealing materials make maintenance easy. Metal seals (Au).
(6) Particle-free structure.
(7) By using a metal case and various types of filters, steady operation can achieve even in an environment of high-frequency noise and stationary magnetic field.
(8) Based on RoHS.

4. Specification / Dimensions

(1) Specification

Name	Mass Flow Controller	
Model	MC-3102L-TC	MC-3202L-TC
Standard flow rate in nitrogen	10 SCCM to 5 SLM	~25 SLM
Operating temperature (High temperature part) -L	80 to 100 ℃·0 to 80%RH (Condensation should be avoided)	
-H	100 to 120 ℃·0 to 80%RH (Condensation should be avoided)	
Operating temperature (Control part)	5 to 50℃·0 to 80%RH (Condensation should be avoided)	
Baking temperature	Below 150℃	
Valve operation mode	Normally closed valve	
Internal surface treatment	-TC: No treatment -SC: Precision polishing	
Minimum controllable flow rate	2%F.S.	
Analog flow rate output signal	Proportional to flow rate 0 to 5VDC	
Analog flow rate setting signal		
Accuracy	±1.0%F.S.	

Repeatability	±0.2%F.S.	
Response time	1 second (Typical)	3 seconds (Typical)
Operating differential pressure	50 to 300kPa	150 to 300kPa
Maximum operating pressure	300kPa(G)	
Withstanding pressure	1MPa(G)	
Storage temperature & Humidity	5 to 50℃·0 to 80%RH (Condensation should be avoided)	
Leak integrity	Less than 1×10^{-11}Pa · m^3/sec (He)	
Mounting direction	Free	
Wetted materials	Stainless steel 316L, PTFE, Au	
Seal Materials	Au	
Actuator	Solenoid actuator	
Fittings	6.35VCR (124) 6.35SWL (127)	
Power supply	+15VDC±3%: 100mA -15VD±3%C: 200mA	
Digital interface	RS-485 (2-wire)	
Option	B: Applied to liquefied gas	
Weight	Approx. 1.2kg (Controlling part 0.2kg, High-temperature part 1kg)	

·Connect the MFC to the frame ground.

(2) Dimensions
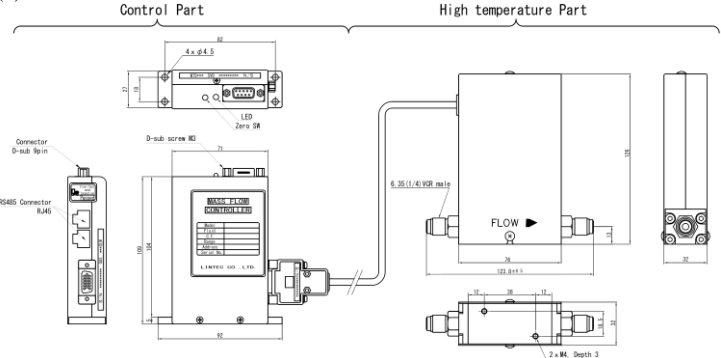
5. Ordering information

MC-3102L – TC - 4JR2 BL0A0 – dd – ee - ff
[1]　　[2]　[3]　[4]　　[5]　[6]　[7]

[1] Series model MC: Mass Flow Controller Series
MC-3102L: Small flow rate   MC-3202L: Large flow rate
[2] Inner surface treatment
-TC: No treatment   -SC: Precision polishing
[3] Fitting
4JR1: 6.35UJR106, 4JR2:6.35UJR124
4VR1:6.35VCR106, 4VR2:6.35VCR124, 4SWL :6.35SWL
[4] Optional
B: Applied to liquefied gas, J: Valve is closed at below 2% setting
L: Temperature range 80 to 100℃   H: Humidity range 100 to 120℃
※Default setting is labeled "AA0A0". Please consult for more information.
[5] Gas type
[6] Full scale flow rate
[7] Flow rate unit
SCCM (0 ℃ standard), SLM (0 ℃ standard)

6. Connection

(1) Analog interface connector
Mounted connector   : D-Sub 9 pin(male)
Pair connector   : D-Sub 9 pin(female)   (Fixed size of screw : M3)

Pin No.	Single name	Function
1	Valve on-off input (Note1)	+15VDC: OPEN, -15VDC: CLOSE
2	Flow rate output signal 0 to 5VDC	Flow rate output voltage plus side 0 to 5VDC
3	Power supply input +15VDC±3%	Power supply (plus) 100mA
4	Power supply COMMON (Note2)	COMMON ±15VDC
5	Power supply input -15VDC±3%	Power supply (minus) 200mA
6	Flow rate setting signal 0 to 5VDC (Note1)	Flow rate setting voltage plus side 0 to 5VDC
7	Flow rate output COMMON (Note2)	Flow rate output voltage COMMON
8	Flow rate setting COMMON (Note2)	Flow rate setting voltage COMMON
9	N.C.	N.C.

Note1) Input impedance of flow rate setting signal is 100kΩ. Valve override impedance is 100kΩ.
Note2) Pin No.4,7,8 are connected internally.

Wirings should be done as shown below in order to remove the effect of potential difference among the COMMON.
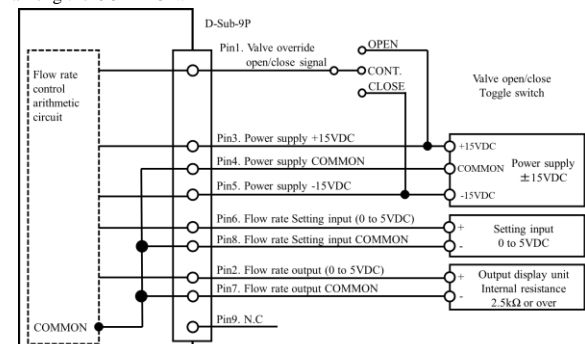
Do not connect. Flow rate setting signal COMMON[8],Flow rate output signal COMMON[7], and Power supply COMMON[4] in the power supply unit.

(2) Digital interface connector

Mounted connector : RJ-45 Modular jack
Pair connector : RJ-45 Modular plug

Pin No.	Signal name	Function
1	Signal COMMON	RS-485 Signal COMMON
2	Signal COMMON	RS-485 Signal COMMON
3	N.C.	N.C.
4	Signal [- Txd / Rxd]	RS-485 2-wire system transmitter. receiver minus signal
5	Signal [+Txd / Rxd]	RS-485 2-wire system transmitter. receiver plus signal
6	N.C.	N.C.
7	N.C.	N.C.
8	N.C.	N.C.

7. Alarm functions

This MFC features two alarm modes: alarm A and alarm B. Using a digital interface, alarm output of the digital connector or LED indicator located on top of the MFC housing can monitor the alarm status. As alarm settings can only be changed using digital communication, please carry out necessary changes using this method. For details, please refer to the Interface Instruction Manual.

Alarm	Set off	LED indicator
A	Setting value≠ flow rate output	Continuous Red
	Flow totalizer Alarm level 2	
	Power supply voltage (+15VDC) drop	Off
B	Voltage of valve control change	Red (every 0.5sec flashing)
	Abnormal zero offset (Note3)	
	Flow totalizer Alarm level 1	
Other	Command error	Continuous Red (every 0.5sec flashing)
Normal	-	Green (every 1sec flashing)

8. Initial setting value (factory shipped value)

This MFC is provided with a software switch for operation mode setting. Before operation, input the necessary data for various functions by using the digital interface. Details of the functions are described in the special function manual.

Software switch	Available values	Function	Default
Device number	00 to 99	MFC No. Registration	00
Alarm A range	0 to 99 [%]	Setting Alarm A range	5%
Alarm B range	0 to 99 [%]	Setting of Alarm B range	20%
Alarm timer	0 to 99 [seconds]	Setting of Alarm timer	5 seconds
Alarm A output	Enable / Disable	Setting of Alarm A output	Enable
Alarm B output	Enable / Disable	Setting of Alarm B output	Disable (Note3)
Operation mode	Analog / Digital	Switching of Analog/digital	Analog
Power on mode	Analog / Preset	Switching of Operation mode in power turning on	Preset
Valve control	C / O / H / S	Close / Open / Hold / Servo	Servo
Control speed	FAST / SLOW	Switching of Response speed	FAST
Control mode	2%Close/2%Hold/ Normal	Control mode switching (at flow rate setting <2%) 2%Close: Valve Close 2%Hold: 2% Control Normal: Normal Control	Normal
Conversion factor	0.6666 to 1.500	Conversion factor setting	1.0000
Communication protocol	9600 to 38400bps	Baud rate	9600bps
	8bit / 7bit	Character length	7bit
	Odd/Even/ None	Parity	None
	1bit / 2bit	Stop bit	2bit

Note3) Zero adjustment error alarms regardless of the "Enable" / "Disable" of the alarm.
·If a zero-set input of longer than 5seconds is input the Baud rate will be set to 9600bps and other communication protocols will be returned to initial value (factory shipped value).

9. Operation

(1) Procedure
1) This product is packed in a clean room before shipment. Please break the seals in a clean room after taking it out of its box.
2) Check the gas type and flow rate, and check the direction of the gas flow and the MFC before installation.
3) Please set up the high temperature part in a thermostatic bath. When using a heater, set up the heater in a way of not causing temperature distribution (When controlling the liquid by vapor pressure, set the temperature of main body higher than the liquid temperature. Recommended time: above 20 ºC)
4) Check for gas leaks from the tubing with a helium (He) leak detector.
5) Connect the interface connectors according to the Connector tale.
6) Power requirements are +15VDC: 100mA and -15VDC: 200mA. Check the voltage, polarity, and capacitance of the power supply voltage.
7) This product consists of a control part and a high temperature part. Be sure to connect the control part and the high temperature part of the same serial number before supplying power to the control part. Incorrect procedure may cause damage to internal equipment. Also, please supply the power supply, warm up the high temperature part to the specified temperature range and warm up for 2 hours or more (Please carry out until the main body temperature reaches the same temperature as the ambient temperature).
8) Adjust the zero point by pressing the zero adjustment, switch located on the top of the MFC. Before zero-point adjustment, check that gas is not being supplied and the device was warmed up for 30 minutes or more in order to ensure sensor stability.
9) Input the flow rate setting signal and supply gas with required differential pressure to the MFC. The MFC will begin to control the gas flow in proportion to the preset voltage. Full-scale voltage is 5VDC. Maximum input voltage is ±15.5VDC.
10) When the output flow rate signal is used, the tolerance voltage of the external device should be more than ±15.5VDC. When it's connected the output valve may be within the range of the maximum voltage ±15.5VDC.
11) Complete shut off cannot be achieved with the mass flow controller. If complete shut off is desired, a shut-off valve should be installed.
12) When a highly reactive gas is used, thoroughly purge all foreign matter from the tubing and the MFC before operation.
13) When contaminated gas is used, install a filter at the equipment inlet.
14) Use the MFC within the range of the operating temperature, and keep it at the same temperature with the gas. If used in any environment that does not meet the above-mentioned requirements, the flow rate cannot be measured accurately and the device may fail.
15) Do not switch the power supply on and off within one second. It may cause failure.

(2) Valve control signal
The MC features a forced valve open/close input function.
The connector pin No.1 is used to input the internal valve open/close signal. By inputting this signal, a forced opening/closing of the internal valve can be performed without depending on the value of the flow rate preset signal.
When +15VDC is input: fully open
When –15VDC is input: fully closed.

(3) Conversion factor
The MFC is preset based on the kind of gas and the flow rate. If a gas that is not specified is supplied, the controlled flow rate may be different from the actual flow rate. This difference is called a conversion factor, and is normally represented by a ratio with N_2. When gas B is fed into the MFC, which was calibrated with gas A, the controlled flow rate is shown below.

$$\text{Flow rate of Gas B} = \frac{\text{Conversion factor of Gas B}}{\text{Conversion factor of Gas A}} \times \text{Flow rate put value}$$

The accuracy of this value may be decreased if the character of the gas is greatly different. Also, the value of the MFC has been adjusted based on the viscosity and density of the gas, therefore if a gas other than the calibration gas is applied, the operating pressure range may be altered. The conversion factor can be set at any desired value, with an operating range of 0.6666 to 1.5000. If the conversion factor value exceeds this range, the operation of the MFC become unstable. The accuracy is different from the standard specifications of the MFC, when the conversion factor is changed.

(4) Digital interface
The MFC features the RS-485 serial digital interfaces. Many special functions can be employed using the digital interfaces. Please refer to other manuals (Digital Interface Manual, Special Function Manual, Command Chart).

(5) For general gas control
1) The heat exchange of gas should be made thoroughly to prevent any difference between the gas temperature and the temperature of the main body. When there is a big difference between them, errors occur in the controlled flow rate.
2) Do the temperature control to prevent rapid changes in the temperature of main body as well as the gas temperature.
3) When adding a heater to the main body, install the heater in a way of not causing the temperature gradient of the main body.
4) The temperature of the main body should not exceed 120 ℃.

(6) For liquid control by vapor pressure
1) Check whether the vapor pressure of the liquid is sufficient (and the temperature is appropriate).
2) Check whether there is dissolved gas in the liquid (or whether the vacuum degassing has been made thoroughly).
3) Check whether the surface area of liquid level in the tank is proportionate to the flow rate in use (If the surface area is small, the control becomes unstable due to changes in the temperature distribution and vapor pressure. In some cases, it may become hard to obtain the required flow rate).
4) Do not heat up the liquid locally. Just as the above-mentioned, doing so may cause a great change in temperature distribution.
5) Control the temperature of tubing and MFC to make a gradual rise in temperature at the downstream side.
6) If the used materials have reactivity with moisture and oxygen, thoroughly purge all foreign matter from the tubing and the MFC by baking and vacuuming before operation.
7) Be sure to do baking and vacuuming after using to keep no residual gas inside. If it is left with residual gas inside for a long time, it may become very hard to liquefy again, and the MFC cannot be reused.
8) In the case of internal liquefaction due to the temperature management bias, after long hours of purging and vacuuming, it can be used again as long as it has not been corroded by liquefaction.

10. Product warranty

(1) Period
This product is guaranteed for a period of 1 year from date of shipment. Defects are repaired according to the following regulations.

(2) Scope
Warranty coverage is restricted to this product only. Any other damage caused by this product is not covered.

(3) Disclaimer facts
The following repairs are not covered by the warranty:
1) Failure caused by by-product of fluid used.
2) Failure caused by misuse (including careless operation) or incorrect repair or modification.
3) Failure caused by dropping after purchasing.
4) Failure caused by a natural disasters.
Even if the warranty period is still in effect, the following items may not be repaired.
1) When the kind of fluid used in the product is unclear.
2) The product is returned with fluid remaining inside and safety cannot be confirmed.

The MFC is a precision instrument. Control may become unstable if electric noise, temperature change of fluid, pulsation of fluid pressure etc. occurs. Please be forewarned.
This instruction manual is subject to revision without notice.